E/CONF.39/A/387
5 Dec.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A.4.1

United Nations

APPROACHES TO AN ENERGY POLICY IN A DEVELOPING COUNTRY

By The Department of Economic and Social Affairs, United Nations, New York

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APPROACHES TO AN ENERGY POLICY

IN A DEVELOPING COUNTRY

A.4.1.

by

the Department of Economic and Social Affairs

United Nations, New York

I. Introductory remarks

1. The formulation of a policy for energy development raises a vast and complex set of problems which this paper cannot pretend to cover in a comprehensive way. It refers mainly to some of the issues emerging from the experience gained in United Nations Technical Assistance and related operations in developing countries, and, in particular, in those which are poor in energy resources.

2. An attempt will be made to point out what seems to be a necessary sequence of steps to be taken prior to the framing of an energy policy; the necessity for an integrated approach to energy problems covering mineral fuels and electricity, as well as the non-conventional sources of energy; the setting of goals consistent with the overall economic and social aims to be achieved; and finally the possible advantages of international co-operation in the field of energy development, especially in the case of smaller countries and those not richly endowed.

3. Energy plays a most important role in economic development since the extent to which it is available will either stimulate or impede the process of economic growth. And, in this respect, it is perhaps electric power which is the most important agent of both technological change and economic progress in developing countries. In most cases, the rate of electrification will set the pace for the development in all other fields of the economy. Because most of the engines and machines that turn out the goods of modern civilization are essentially means for supplementing human and animal energy with the immensely greater potential

of mineral fuels and water power, the differences in per capita national income are closely related to differences in per capita energy consumption. 1/

4. However, generalized statements on energy problems in developing countries may easily be misleading since conditions vary greatly from one country to another, both as regards resource endowment on the one hand, and the targets set and methods employed in the effort to develop the economy on the other.

5. The term "energy" used throughout the present paper should be understood to represent an abstract concept which may sometimes obscure the real issue and processes at play. The term "energy" is only a convenient abbreviation for what is after all a conglomeration of heterogeneous elements, such as hydro-power, coal, petroleum, natural gas and so on. Physical and economic characteristics of these energy sources differ greatly, and even where there are technical possibilities of substitution, they may not always be economically feasible.

6. The degree of availability of various indigenous energy resources will certainly be reflected in the national approaches to energy problems. While in a few countries one may find an abundance of coal, hydro-power, petroleum and natural gas, others may possess commercial quantities of only one of these resources. Finally, there is a number of developing countries which are very poor in any known kind of domestic energy resources.

7. On the demand side, while in some countries the emphasis is clearly on industrialisation on a broad front, in others the development of agriculture and primary industries may take precedence. The pattern of development will greatly influence energy requirements and energy policies.

II. Prerequisites for energy policy formulation.

a) Estimates of present and future requirements of energy

8. Prior to the formulation of an energy policy it is necessary to assess the national energy requirements and to compile an inventory of the known energy resources. In estimating energy requirements, it should be pointed out from the

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1/ Low per capita consumption of energy is a common feature of all underdeveloped countries. Expressed in kilograms of coal equivalent, in 1960, per capita consumption in Yemen amounted to 6 kilograms of coal equivalent, in Ethiopia to 8, Afghanistan to 14, Somalia to 24, Nigeria to 39, Sudan to 50, Pakistan to 67, India to 140, while in the United States it was in excess of 8,000 and the United Kingdom reached a consumption of almost 5,000 kilograms per head of population. (World Energy Supplies 1957-1960, Statistical Papers, Series J, No. 5, United Nations, New York.) Figures given as examples, however, generally understate the real energy consumption as they do not take into account the non-commercial sources of energy, which in some developing countries may contribute as much as two-thirds or even more of the total energy consumption.

very outset that the term "requirements" tends to be somewhat ambiguous and rather difficult to define. It is obvious that energy consumption is closely tied to economic growth and the proper starting point for estimates of future energy requirements is thus a consideration of the prospects for future economic growth.

9. While projections of past trends may prove reasonably useful in mature economies where a certain continuity of development might be anticipated, regression analysis or similar methods of projection in developing countries could easily be misleading because of:

i) the rather discontinuous character of economic development itself, implying profound structural changes;

ii) inadequacy of data for the past period.

10. In very broad terms, the assessment of energy requirements in a developing economy falls into two main categories:

i) evaluation of effective demand in the monetized (as opposed to the subsistence) sector of the economy, which can be quantified on the basis of an estimate of the requirements of the developing industries and transport, as well as household consumption in and around the existing nuclei of development;

ii) an assessment of "felt needs" (which are not yet backed by demand in the strict sense of the word, i.e., by existing or expected purchasing power) - which are very much a function of general plans for social and economic development of areas still predominantly of a subsistence economy type. The satisfaction of such needs will depend on the political and social goals set by the government as well as on the availability of capital over and above that earmarked for the already existing or projected centres of industrial expansion.

b) Inventory of known energy resources and facilities

11. The second preliminary to energy policy formulation is the preparation of an inventory of the utilised or known energy endowment as well as the existing processing and distribution facilities in the energy sector of the economy.

12. An assessment or evaluation of energy resources on a national scale may be undertaken for either one or both of two purposes. The first purpose is an immediate one: to identify (that is to find and measure) resources that are or can be economically exploited under present conditions. Such an activity is normally the function of an agency like the Geological Survey or Hydrological Survey and is of special importance in developing countries. The second purpose of energy resource evaluation may encompass the first but has as its main focus the long-term future. This purpose is assuming increasing importance all over the world as greater attention is given to long-range programming with the improved techniques for undertaking it.

13. The first kind of inventory should, of course, be considered as an urgent task, particularly in those countries where data on resource use are scanty. This inventory should provide at least a minimum of technical and economic information on which to base forward planning.

14. The basic data required should include:

i) for hydro-power: the known power potential, installed capacity, size of units, location of power plants, the output and its seasonal variations, cost, degree of utilisation and stand-by capacity and technical characteristics of equipment;

ii) for coal and lignite: known reserves, capacity and location of mines, output, cost and utilisation;

iii) for petroleum and natural gas: proved reserves, location, output, quality, cost and utilisation. Similar data should be assembled for geothermal energy, if present.

15. In addition, it would be useful to have some information on non-commercial sources of energy, such as wood, straw, dung....., particularly in the household and agricultural sectors.

16. Data should also be compiled on the various energy processing plants, such as thermal power stations, petroleum refineries, coal washing plants, gas works, etc., covering the capacity of plants, location, load factors and costs, as well as the organisation of the power systems.

17. The inventory should contain information on existing electric power transmission lines and distribution systems, on pipelines (capacity, length, utilisation and cost), on railway lines and the cost of transport per ton of coal or petroleum, on the costs of transport of fuel by road and on natural gas distribution systems.

18. Furthermore, it is necessary to make an analysis of available energy end-products within the country, including an analysis of costs to consumers in different regions. In this context, information is also required on imports of energy products (or exports if any), their cost (or earnings) in foreign currency, their costs to consumers (c.i.f. prices plus taxes, transport and distribution costs within the country).

III. Stages of Energy Development.

19. The development of energy supplies basically involves five stages: a) energy exploration; b) the expansion of primary energy supply; c) the provision of energy-transport facilities; d) the construction of energy-processing facilities, if needed; and e) the establishment of distribution facilities.

a) Energy exploration

20. General geological exploration and mapping of surface indications is a necessary long-term task providing basic multi-purpose information. The proving of energy reserves, however, involving as it does, in the case of fuels, drilling and many other capital-intensive activities, is a matter which should be determined, as to its intensity, timing and scale, by the energy needs of a country within the context of the overall economic development programme. In other words, a country which already disposes of well located known energy resources of high quality for fifteen or more years to come should not consider capital-intensive exploration as a task of high priority.

b) Expansion of primary energy supply

21. The point just made is of even greater relevance when considering the development of a mine, petroleum or steam field, or hydro-power site. Heavy initial investment is sometimes undertaken on the erroneous assumption that once the primary source of energy becomes available, subsequent stages will be more easily financed. Such reasoning can lead, for example, to the construction of hydro-power stations which cannot be put into operation because no provision, or inadequate provision, has been made for the construction of transmission lines.

22. It is also important to attempt to determine in advance the probable cost of the power supplies to be developed. While energy costs vary considerably, and what is acceptable ranges fairly widely, it is useful to compare the estimated costs with a typical range so as to judge whether they are likely to be economic. 2/ When considering the investment requirements for hydro-power, it is not enough to take the figure for costs per kilowatt of installed capacity; it is also necessary to consider the volume of output - the kilowatt-hours to be produced per kilowatt of capacity, which will depend on the storage, flow characteristics of the river, and similar factors. 3/

c) Provision of transport facilities

23. In transportation, the economies of scale have considerable significance. Large quantities, and only large quantities, can be moved economically over comparatively great distances. This is basic for all energy supplies and applies to pipelines, transmission lines, railways and tankers. 4/ Transportation of coal and oil is generally most cheaply effected by water transport, followed by pipelines, railways and trucks, in descending order; the means of transport usually

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2/ In coal development, an investment range of up to $10 per ton of annual capacity is considered low, $10 to $20 reasonable, and over $20 as high - taking into consideration, of course, the quality of the coal, its location and similar factors. Investments of more than $40 or $50 per ton have, nevertheless, been known to be made, and they resulted, needless to say, in very expensive coal.

3/ For a large hydro-power plant with an average utilisation of, say, 5,000 hours a year hydro-power will be very cheap if the investments per kilowatt are to amount to less than $100; fairly cheap if they are to be less than $200; reasonable if they are to be $200 to $400; high if they are to exceed $400. A small micro station may cost as much as $800 per kilowatt; but on the other hand it may require practically no other investments. If it can be expected to operate at a reasonable or high utilisation factor, the investment may be well justified. Similar key data are available for geothermal and other sources of energy. They offer a useful yardstick for measuring probable costs of primary energy supplies.

4/ Electric power generated by a 10 MW station can only be economically transmitted within a 50-80 kilometre radius. Small energy deposits and small power plants can be economically utilised only on a local level.

being determined by the distance and topography involved. While keeping in mind specific local conditions, programming of energy transport facilities should be based on the available data on typical cost and time requirements for each form of transport.

d) Construction of energy-processing facilities

24. Space does not permit a thorough discussion of thermal power plants, refineries, coking and briquetting plants. However, it may be mentioned that it takes three to four years to build a central thermal power station and at least two years to add more plant to an existing station. 5/ The time required for the construction of a small refinery usually varies between 18 and 24 months. 6/

e) Establishment of distribution facilities

25. Distribution facilities for electricity may be very capital intensive. Where electricity is sold to a large number of small consumers spread over a considerable area, the distribution network may require more capital than was required for generation and transmission. The same applies to the distribution of gas and, to a lesser degree, to petroleum products. Capital requirements for distribution are, therefore, a subject which should be carefully scrutinised.

IV. Decisions and Choices

a) Framework - the overall development programme

26. In developing countries, economic programmers operate under conditions of extreme scarcity as well as under pressure of urgency. Claims on capital are manifold and only a minor share of investment may be earmarked for the energy sector. 7/ Furthermore, energy development will have to be closely co-ordinated

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5/ Capital cost of building a conventional thermal plant will range from $100 to $250 per KW installed. At least as much has to be invested in transmission and distribution facilities.

6/ A refinery with a throughput of one million tons a year will today cost 30 - 40% less than it would have done a few years ago - which is another result of technological progress from which developing countries can benefit.

7/ In India, where much more attention is paid to the development of energy resources than in most other developing countries, about 7 per cent of total investment in the Second Plan and 10 per cent in the Third Plan were allocated to electric power. The allocations for petroleum and coal were considerably lower than those for power development.

with the requirements of other sectors, in particular with those of industry and transport.. In fact, a slight excess of energy supplies over anticipated requirements will probably prove to be a precondition for a smoother implementation of overall development programmes, since a shortage of energy will delay the fulfillment of other planned objectives. It is, therefore, recommended that a certain amount of reserve energy capacity should be provided for; although, in so doing, care should be taken to avoid tying up scarce capital in investment which may not be fully utilised. On the other hand, when deciding on the development of industries, it should be kept in mind that the most capital intensive are usually also the most energy intensive. As the means for the development of an energy basis tend to be limited, there is a very strong case for good husbanding of energy resources. This is not necessarily to imply that a policy of natural resource conservation should be adopted, since other resources (such as capital) may be even more limited, but rather to suggest that when faced with a choice of different types of industries, preference might be given to those which will be capable of operating economically with more modest energy inputs. However, this recommendation should not be applied inflexibly. For example, when faced with a possible excess capacity of cheap hydro-power and the availability of, e.g., bauxite, there should be no reason not to develop an energy-intensive industry as that of aluminium.

27. As already mentioned, the overall development programme will also have to determine the amount of capital to be made available for the development of an energy infrastructure, in particular in those parts of a developing country which are still without any electric power supply and continue to live within a framework of subsistence economy. Investment in energy infrastructure, especially in that of electric power, will create external economies for other sectors of the economy - but it is very difficult to measure or predict its possible returns. Provision of power for future regional centres (with hospitals, schools, repair shops, etc.) in backward and remote areas may prove to be an important catalyst of economic development, creating new jobs, diversifying the economy and also creating skills for industrial development at a later stage. The decision on how much to invest in such projects will be largely based on political and social considerations. Thus, the energy programmer has to operate under a set of constraints resulting from the general economic policy of his country. These will determine the amount of capital and of foreign currency at his disposal as well as the general priorities he will have to comply with, such as the industries which will have to be provided with power, the areas to be electrified and so on. Within the framework of these constraints, he will still be faced with a number of choices and decisions. These will involve technological and economic considerations in respect of the choice among different types of energy resource and end-products; timing of projects; size of plant and economies of scale; problems of location and transport; degree of capital intensity; possibilities of saving foreign currency, as well as problems of pricing rates, taxation, etc.

b) Technical progress

28. Despite all their difficulties, the countries now embarking on economic development start from a better initial position than did the presently developed

countries, and this is perhaps particularly so in regard to energy, in so far as they can make full use of technological progress of the last half century. They will benefit, for example, from a more efficient use of primary energy in power production, from new techniques for the improved utilisation of power, and last but not least they will have at their disposal not only a number of new sources of energy but also some recently developed cheaper forms of small-scale energy production.

c) Applicability of market criteria

29. It is open to question whether the problem of energy programming can be rationally undertaken only in terms of costs and profits of individual enterprises, i.e. whether one can exclusively rely on market criteria. Profitability from a market point of view should not be the only criterion for investment which has as its purpose the creation of external economies for other sectors of the economy, and above all for the infant industries. In fact, a whole cumulative expansion process has to be blue-printed in terms of investment projects and their effect on the volume of production, on consumption, on employment of workers and natural resources, and on health and productivity of labour in various sectors.

d) Timing

30. Faced with this complex process of planned economic development, the energy programmer has to devise the means of bridging the gap between the energy supplies available today and the requirements, say two, five or ten years hence. He has also to take account of the gestation period of different energy projects, the size of investment required, as well as the economic efficiency of the proposed solutions.

31. A shortage in the available primary energy supplies, for instance, might be overcome by the development of known local energy resources or by increased imports or by exploration for new or additional energy resources. The speediest method to increase the availability of primary energy supplies is obviously increased imports, but imported energy supplies always require foreign exchange and may raise a balance of payments problem. The development of known energy resources requires much more time, and again some of the known energy resources may not allow low-cost energy production; and exploration for new energy resources is obviously a very long-term undertaking. If means are available, it may be appropriate to adopt all three measures - providing for an immediate increase in supplies through imports; for further local production within a few years; and for large domestic supplies in the longer run through an active exploration programme. Thus, successful programming in primary energy resources development will depend in large measure upon proper timing factors in a given situation. Petroleum fields, for example, can be developed in a relatively short time span - a field can be put in operation in one or two years. A coal mine, however, unless it is a surface mine, requires more time, usually between two and five years. Moreover, in underdeveloped countries, time requirements are usually somewhat greater. The construction of a hydro-power plant may require 4 to 8 years, but has been known to take more than 10 years in some cases. As the

development of a primary energy resource often lags behind energy requirements, it sometimes becomes necessary to resort to temporary means pending completion of more time-consuming energy-producing facilities. It is possible, for example, to use small diesel plants to bridge the gap until the completion of a hydro-power plant. 8/

e) Problems of scale and location

32. Despite encouraging progress achieved in reducing the costs of small-scale power production or in building refineries, economies of scale both in energy production and transportation are perhaps more important than in any other sector. A modern 275 MW thermal power unit compared with one of 30 MW has an approximately 40% better index of thermal efficiency, and capital costs per KW installed are also about 40% lower. Operating costs tend to decrease likewise. Relative costs of processing 1 barrel of crude oil in a simple refinery with a throughput of 500,000 tons per year are about 2.3 times greater than in a 4 million ton per year refinery. In transportation these trends are even more marked. A 275-kv transmission line may be 2.6 times dearer per kilometer than a 132-kv line, but its capacity will be 6.2 times bigger. The same general tendency applies to pipelines, tankers and so on. This would tend to show that concentrated development of energy resources in locations where demand is heavy would yield far better returns than wide-spread small-scale development. However, the economies of scale can only be derived where the rate of utilisation of equipment is high and, therefore, stress should be laid on determining the optimum scale of operations, especially since the conditions prevailing in most developing countries (with the exception to some degree of such large countries as India, Brazil and Pakistan) are not conducive to large-scale methods of energy development. The actual and even the prospective requirements will rarely warrant it and, in addition to this consideration, it should be recalled that there is also considerable pressure to expand the energy infrastructure of the country as widely as the available means permit. The energy programmer will, therefore, more often than not be called upon to strike some kind of a balance between the attractions of the economies of scale tending to concentration of production and to transportation in bulk, and the tendency to build a number of smaller installations as close as possible to the scattered minor centres of consumption. In any case, the

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8/ Experience has shown that, where in developing areas a beginning of public electric supply is warranted, a sound procedure is to install diesel generators, say, of 1,000 to 1,500 KW unit size. Owing to their limited cooling water requirements and low weight (reducing foundation problems) there is considerable freedom of siting. By the time the demand for power has reached, say 7/8,000 Kw, the future development and requirements of the area would be clearer cut and it should be possible to make a full economic study of the relative advantages of separate power stations with individual networks, or possibly a wider network with one major central steam turbine or hydro-electric station. If it should be decided to build such a central station the diesel generators could be picked up and installed in some other area where electric supply is beginning to be required. (Michael Hubbard: The Use of Oil in Developing Countries, Paper A17, World Power Conference, Belgrade 1957, p. 15)

programming of small isolated plants should be of such a nature as to permit integration into more comprehensive systems at a later date.

f) Capital and foreign currency requirements

33. Another important factor which tends to limit the size of projects in developing countries is the amount of capital required. For this reason there may be certain aspects of energy programmes which will have to be based on less costly solutions, which, from a technical point of view, may not be the most efficient. Moreover, the foreign currency component of almost all energy projects is usually very high. The proportion of equipment to total capital expenditure amounts to about three quarters for electricity supply undertakings, coke ovens, gas works and oil refineries. For collieries it usually approaches two-thirds. By far the largest part of this equipment will have to come from abroad and the foreign exchange component in the capital outlays for a thermal plant may easily amount to 80% or more of the total. In the construction of hydro-power plants this component will be considerably lower because of the large share accounted for by civil engineering work which may be undertaken by local personnel. Hydro-power plants permit a further saving of foreign currency since they reduce imports of fuel. However, in many cases these considerations will have to be weighed against the long gestation periods required for the erection of such power plants. Furthermore, in addition to the detailed study of capital and time requirements, careful attention should be paid to the cost per unit of output, which comprises both capital charges and operating costs. Capital charges are in turn a function of the amortization period, or life expectancy, of the various facilities to be installed. 9/ Capital requirements, therefore, are not a sufficient basis for valid economic comparisons. If the amortization period is taken into account, it will be found that a diesel plant, though involving a relatively small investment, will nevertheless produce expensive power, because it has to be amortized in a comparatively short period - 10 years - and also because it consumes a high-cost fuel. Because of the capital-intensiveness of energy industries, capital costs are often a factor of over-riding importance in energy programming. Refineries and pipelines operate economically only if their operation is continuous - day and night, and all year round - since their fixed costs constitute a very high percentage of total costs. If hours of operation drop from, say, 8 thousand hours to 4 thousand hours per annum, cost per ton is likely to jump four-fold. In coal mines, on the other hand, where wages constitute a relatively larger share of total costs, a curtailment of operations will not bring such a sharp cost increase. A developing country will thus need to consider very carefully the capital and foreign exchange implications and to balance the initial costs of alternative schemes against their subsequent operating costs.

9/ Hydro-power plants are amortized over 35 to 50 years; thermal power plants over 25 to 35 years; diesel plants over 10 years, refineries and pipelines over 15 years; wooden poles for transmission lines over 20 years; steel poles over a period of up to 50 years; railways over 25 to 40 years and so on.

g) Taxation and pricing problems

34. A rather sensitive area for policy decisions is the complex of pricing, rate setting and taxation. Though the price elasticity of demand for energy products in most developing countries tends to be rather low, experience shows that taxation may still have quite some impact on the patterns of demand. Therefore, both rate setting and taxation policies may constitute an important instrument for the government to orientate the development of energy resources in one direction or another.

35. A policy of cheap energy may have a stimulating effect on overall economic development. It has, however, to be balanced against the possible shorter term difficulties which may arise from a reduction of government revenue (in the form of taxes and duties on imported fuels or machinery, which in some cases represent a very substantial share of total government receipts), and it may also reduce the returns of energy undertakings, therefore rendering more difficult the payment of debt and other charges as well as postponing further the break-even point at which these undertakings would become profit bearing. All these considerations require very careful study and should be weighed carefully one against the other.

36. Another point in this context seems worth mentioning. Consideration should be given by policy makers to the possibility of evolving differential tariffs and rates so as to promote consumption by certain categories of consumers (such as industries enjoying a priority under the overall development plans or certain groups of population among which it is the government policy to encourage the utilisation of energy). Some thought may also be given to a rate structure designed to lighten the burden on the consumers during the first years, while the development process is only getting under way, with a view to increasing the rates progressively as the ability to pay becomes greater.

V. Need for a Centralized Agency Responsible for Overall Energy Policy

37. In spite of the integrated character of the various aspects of energy development, in many countries the different aspects of the energy economy are handled by a number of independent and unrelated authorities. One ministry will often be responsible for the mining policy, another for the imports of fuels, a third for power development and so on. The necessity for integrated thinking, integrated policy and even integrated and unified implementation of energy development plans has gained considerable recognition in recent years, however, and a number of developed countries have established unified central bodies to deal with energy matters, e.g. United Kingdom, France, Italy, Belgium.
An integrated energy policy and a unified authority over energy matters is even more important to developing countries. Such an authority should work closely with, or even be a part of, the body deciding on overall development policies.

VI. International Co-operation in the Development of Energy-Resources

38. Capital scarcity, lack of resource endowment, narrow markets which tend to preclude economies of scale and other factors hampering the development of an

energy basis in a developing country might, under certain conditions, be overcome or at least alleviated if neighbouring countries - or a number of countries within a region - were to pool their resources and attempt to co-operate in their development. The Mekong scheme, the Iron Gate project, the idea of co-operation in the use of natural gas in Asia and the Far East mentioned at the Second ECAFE Petroleum Symposium at Teheran, as well as a number of other schemes already in operation, seem to indicate that there is an increasing awareness of the mutual advantage to be gained by such co-operation.

39. The United Nations, the specialised agencies and related international organizations have made a considerable effort in assisting developing countries in the field of energy. 10/ A number of United Nations Technical Assistance experts have advised governments on energy policies and tariff problems as well as on specific technical matters. The Lower Mekong Basin development scheme in addition to similar undertakings now in the offing in Africa are being actively sponsored and co-ordinated by the United Nations and the specialised agencies. The United Nations Special Fund has provided assistance for a number of power surveys. In addition, the United Nations have attempted to train both technicians and administrators dealing with energy problems and have inter alia granted a number of scholarships to such persons. 11/ The International Atomic Energy Agency has promoted the application of nuclear energy by means of studies, conferences, technical assistance and other means. This Agency maintains close co-operation with the United Nations and joint Technical Assistance missions have been sent to a number of developing countries to investigate the possibilities of utilising nuclear power for energy development. The International Bank for Reconstruction and Development regularly undertakes general economic surveys and also investigates particular projects at the request of Governments in connection with the granting of loans. It is expected that these various forms of activities by the United Nations and other international organizations will continue to expand.

10/ Economic Development of Under-developed Countries: Energy Development; Report of the Secretary-General to the 27th Session of the Economic and Social Council (E/3212).

Economic Development of Under-developed Countries: Petroleum Resources; Report of the Secretary-General to the 29th Session of the Economic and Social Council (E/3324).

New Sources of Energy and Energy Development; Report of the United Nations Conference on New Sources of Energy, 1961. United Nations publication, Sales No. 62.I.21.

11/ A number of seminars and meetings were organized both by the United Nations and its Regional Commissions. A first specific attempt to train administrators who are not technicians was made at the Inter-regional Seminar on Techniques of Petroleum Development, held at United Nations Headquarters from 23 January to 21 February 1962.

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